

What is Claimed is:

- [c1] An apparatus comprising:
- a chamber adapted for holding a workpiece having a surface layer adapted for being etched; and
 - a distribution plate including a first plurality of channels for providing a first fluid to flow into the chamber at an angle θ_1 with respect to an exposed surface of the distribution plate and a second plurality of channels for providing a second fluid to flow into the chamber at an angle θ_2 with respect to the exposed surface of the distribution plate;
 - wherein the first plurality of channels and the second plurality of channels are arranged in rings around a common point of the distribution plate.
- [c2] The apparatus of claim 1, wherein each angle θ_1 and θ_2 is at least 45 degrees and less than 90 degrees.
- [c3] The apparatus of claim 2, wherein paths of the first plurality of channels and paths of the second plurality of channels originate in an XY plane of the distribution plate and wherein each angle θ_1 and θ_2 is at least 45 degrees and less than 90 degrees with respect to the XY plane and wherein each angle θ_1 is offset from the XY plane at an offset angle α_1 and β_1 with respect to the XY plane, and wherein each angle θ_2 is offset from the XY plane at an offset angle α_2 and β_2 with respect to the XY plane, and wherein α_1 , β_1 , α_2 , and β_2 are selected from the group consisting of from about 0 to -45 and from about 0 to +45 degrees with respect to the XY plane.
- [c4] The apparatus of claim 1, wherein the distribution plate comprises a material selected from the group consisting of polytetrafluoroethylene, fluorinated ethylene propylene, acetal homopolymer resin, polyimide, polyetherimide, polyarylate, polycarbonate, and combinations thereof.
- [c5] The apparatus of claim 1, wherein the rings of the first and second types are concentric rings, wherein each ring has a diameter from about 1.75 inches to about 7.04 inches.
- [c6] The apparatus of claim 1, wherein the paths of the fluids through the

distribution plate further comprises grooves and wherein a volume of the grooves is greater than a volume of the channels.

- [c7] The apparatus of claim 1, wherein the rings around the center point of the distribution plate have shapes selected from the group consisting of circles, ellipses, rectangles, squares and combinations thereof.
- [c8] The apparatus of claim 1, wherein the chamber further comprises a lower annular ring that includes a plurality of holes extending over an exhaust port.
- [c9] The apparatus of claim 1, wherein the chamber further comprises an upper annular ring, wherein a space is created between an edge of the upper annular ring and a wall of the chamber, and wherein the space restricts a flow of fluids in the chamber.
- [c10] The apparatus of claim 9, wherein the opening between the upper annular ring and either the workpiece or the chamber wall is at least 3/8 inch.
- [c11] The apparatus of claim 1, wherein the distribution plate is located from about 1/8 inch to about 3 1/2 inches from a surface of the workpiece.
- [c12] The apparatus of claim 1, the first fluid comprises ammonia gas and the second fluid comprises hydrogen fluoride gas, the first fluid and the second fluid are adapted to react inside the chamber to form a self-limiting etchable layer on a portion of the adapted surface layer of the workpiece.
- [c13] A method, comprising:
 - providing a workpiece within a chamber, wherein a surface layer of the workpiece has been adapted for being etched;
 - providing a distribution plate over the workpiece, the distribution plate including a first plurality of channels for providing a first fluid to flow into the chamber at an angle θ_1 with respect to an exposed surface of the distribution plate and a second plurality of channels for providing a second fluid to flow into the chamber at an angle θ_2 with respect to the exposed surface of the distribution plate, wherein the first plurality of channels and the second plurality of channels are arranged in rings

around a common point of the distribution plate; and
forming a self-limiting etchable layer on the surface layer of the
workpiece.

- [c14] The method of claim 13, wherein each angle θ_1 and θ_2 is at least 45 degrees and less than 90 degrees.
- [c15] The method of claim 13, wherein the paths of the first plurality of channels and the paths of the second plurality of channels originate in an XY plane of the distribution plate and wherein each angle θ_1 and θ_2 is at least 45 degrees and less than 90 degrees with respect to the XY plane and wherein each angle θ_1 is offset from the XY plane at an offset angle α_1 and β_1 with respect to the XY plane, and wherein each angle θ_2 is offset from the XY plane at an offset angle α_2 and β_2 with respect to the XY plane, and wherein α_1 , β_1 , α_2 , and β_2 are each selected from the group consisting of from about 0 to -45 degrees and from about 0 to +45 degrees with respect to the XY plane.
- [c16] The method of claim 13, wherein a thickness of the self-limiting etchable layer is at least twice as thick as a thickness of a portion of the adapted surface of the workpiece from which portion the self-limiting etchable layer was formed.
- [c17] A distribution plate comprising:
a first plurality of channels for providing a first fluid to flow into a chamber at an angle θ_1 with respect to an exposed surface of the distribution plate; and
a second plurality of channels for providing a second fluid to flow into the chamber at an angle θ_2 with respect to the exposed surface of the distribution plate;
wherein the first plurality of channels and the second plurality of channels are arranged in rings around a common point of the distribution plate.
- [c18] The distribution plate of claim 17, wherein each angle θ_1 and θ_2 is at least 45 degrees and less than 90 degrees.
- [c19] The distribution plate of claim 17, wherein the paths of the first plurality of channels and the second plurality of channels originate in an XY plane of the

distribution plate and wherein each angle θ_1 and θ_2 is at least 45 degrees and less than 90 degrees with respect to the XY plane and wherein each angle θ_1 is offset from the XY plane at an offset angle α_1 and β_1 with respect to the XY plane, and wherein each angle θ_2 is offset from the XY plane at an offset angle α_2 and β_2 with respect to the XY plane, and wherein α_1 , β_1 , α_2 , and β_2 are selected from the group consisting of from about 0 to -45 and from about 0 to +45 degrees with respect to the XY plane.

[c20]

The distribution plate of claim 17, wherein the first fluid is provided to the first plurality of channels and the second fluid is provided to the second plurality of channels without premixing of the first and second fluids.